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THE APPLICATION OF ICT IN THE SELECTION OF COMMUNITY DEVELOPMENT PROJECTS IN NIGERIA

[1]Konyeha S., [2]Konyeha C. and [3]Oyewale A.

[1]Department of Computer Science, University of Benin, Benin City, Nigeria
[2]Department of Electrical Engineering, Benson Idahosa University
[3]DIL, Delta State University, Abraka

Abstract

The aim of this paper is to apply the AHP technique using the PriEsT software in solving a problem of selection of projects by community stakeholders for implementation by government in Nigeria, to enhance economic growth. Using the Delphi method twenty-one community members across socio-economic, gender and age categories were systematically sampled from Egor and Oredo Local government area in Edo state. A Likert scale questionnaire was used to gather up and create criteria which mainly impacts to project prioritization. The AHP method implemented in a software PriEst was used to determine the weights of the decision criteria and rank the alternatives. Analyzing quantitatively the difference between weights from both using the Delphi method combined with the AHP method, the relevant criteria chosen by the respondents in judging an economically viable project were Social impact, economic impact, project constraints/risks and cost. The four projects chosen were borehole, road construction, cab transport line and skill acquisition; based on the prioritization methodology the projects were ranked in the following order: Road construction, cab transport, skill acquisition and borehole drilling. The connected relationship between the two top projects: road construction and cab transport line; shows the AHP method is a realistic means of realizing project prioritization. It is recommended that MCDM methods be institutionalized in the framework of project selection in Nigeria government and corporate establishment.

Keywords: AHP, decision making, criteria, Project selection, ranking method, Prioritization

1. Introduction

A project is a temporary endeavour undertaken to create a unique product, service or result. Temporary means that every project has a definite end. The end is reached when the project's objectives has been achieved, or it becomes clear that the project objectives will not or cannot be met, or the need for the project no longer exists and the project is terminated. Temporary does not necessarily mean short in duration, many projects last for several years. In every case, however, the duration of a project is finite. Projects are not ongoing efforts. Selection of project among a set of possible alternatives is a difficult task that decision maker (DM) has to face [1]. Project selection and project evaluation involve decisions that are critical to the profitability, growth and survival of project management organizations in the increasingly competitive global scenario. Such decisions are often complex, because they require identification, consideration and analysis of many tangible and intangible factors.

ICTs are tools, unless we understand what the tools are for, they are useless. The adoption of ICT is closely related to economic growth. It is a powerful tool for increasing productivity. Productivity gains in Agricultural sector, globally are directly attributed to the technological advances experienced by modern farmers. However, Nigerian economy have been facing several problems in the agricultural sector including food security, access to natural and human resources, population growth, food import values among others[2].

Project selection is one of the important issues in community development, governmental nonprofit and commercial organization. The goal of the project selection process is to analyze project viability and to approve or reject project

Correspondence Author: Konyeha S., Email: susan.konyeha@uniben.edu, Tel: +2349024272174

proposals based on established criteria, following a set of structured steps and checkpoints [3]. The PMI standard for portfolio management [4], suggests a process for portfolio governance involving the following steps: (1) Identify components (projects), (2) Categorize components, (3) Evaluate components, (4) Select components, (5) prioritized components, (6) Balance portfolios, and (7) Authorize components. This logical process is consistent with that proposed by others. An expanded view of this process has been developed as a 'framework for project portfolio selection' [5]. This integrated framework incorporated a sequence of phases: strategic consideration; project evaluation; and portfolio selection. Project portfolio selection is essentially about decision making by individuals and organizations. The effectiveness of this decision making can be influenced by human psychological factors, as espoused in the field of behavioural economics; organizational and cultural considerations; the quantum (too much and too little) and timeliness of information to assist the decision making [9]; and the experience of the decision makers [6].

According to Muller[6], "the difficulties associated with project portfolio selection result from several factors: (1) there are multiple of often-conflicting objectives, (2) some of the objectives might be qualitative, (3) uncertainty and risk can affect projects, (4) the selected portfolio may need to be balanced in terms of important factors, such as risk and time to completion, (5) some projects may be interdependent, (6) the number of feasible portfolios is often enormous. In addition to these difficulties, due to resource limitations there are usually constraints such as finance, work force, and facilities or equipment, to be considered. As some researchers have noted, the major reason why some projects are selected but not completed is that resource limitations are not always formally included in the project portfolio process." Portfolio selection Contributing factors to optimal project portfolio selection.

There are many different approaches or models for the qualitative and quantitative evaluation and prioritization of projects involving numerical and non-numerical methods. There are well over 100 different techniques [7]. Some comments on the range of techniques include: "There are many relatively divergent techniques that can be used to estimate, evaluate, and choose project portfolios. Many of these techniques are not widely used because they are too complex and require too much input data, they provide an inadequate treatment of risk and uncertainty, they fail to recognize interrelationships and interrelated criteria, they may just be too difficult to understand and use, or they may not be used in the form of an organized process [6]; "models do not make decisions, people do"; and "all models, however sophisticated, are only partial representations of the reality they are meant to reflect [7].

2. Related literature

In recent years, many multi criteria decision making (MCDM) methods have been developed for Project Selection problems [8]. In [5], fuzzy 'technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)' and AHP methods for project selection in oil-field development was used. In another work [9],proposed a fuzzy analytical hierarchy process (AHP) - based approach to project selection. In [10], applied MCDM techniques in project selection problem, it was based on AHP and TOPSIS methods. There are various methods on project selection in the different fields. The majority of accomplished works often yield complicated mathematical programming such as mixed integer or nonlinear programming. For example, [5] applied a 0-1 goal programming for project selection problem. Also[11],proposed a multi objective optimization model for project portfolio selection by considering efficiency of human resource. They considered efficiency of each project and economic goal as the objectives of their model. They implemented their proposed model on a real case in the field of e-commerce in Austria.

In [12],a probabilistic integer programming was proposed for selecting R&D projects under uncertainty. The objective of this model was to maximize the rate of return for capital. Also[13], used a goal programming model for information system project selection. However [14], introduced a comprehensive model for the portfolio of several objectives. Again[15], prepared a multi objective integer optimization model with distributions of costs probability, [16]used a hybrid grey rational analysis and non-dominated sorting Genetic algorithm for selection project portfolio. They first ranked the project by grey rational analysis which leaded to find optimal project portfolio. As they consider the risk for project selection, fuzzy environment is used to calculate risk of each project.

Then risk and ranks used in a two objective zero-one programming model and solve it through non-dominated sorting Genetic algorithm for the final selection and any other researches. Many researchers have applied these methods into many organizations and several fields for instance project selection, project performance, logistics and computer system, etc. Three methods were combined in [17] including Affinity Diagram, AHP and fuzzy TOPSIS for improving city sustainability by evaluating four city logistics initiatives, while Pablo et al. [13] applied AHP and ANP to help managers to decide project investment for project selection.

Improving living standards, educational levels and well-being for the entire population are major focus of World Bank assisted, Nigeria funded Community and Social Development Project (CSDP) [18]. It is based on the perception that new communities are dependent on adequate delivery of communal infrastructures and amenities like modern shopping malls, water amenities, good roads, hospitals, communications and network facilities, and other amenities[18]. According to [19], non-governmental organizations (NGOs), have been engaged absolutely in varied acts of corporal communal developmental activities in Nigeria, through different developmental engagements of community-based organizations (CBOs) contribution in the providing infrastructures.

3. Methodology

In this study, the projects under consideration are prioritize by a combination of two techniques comprising of Expert interviews, and the Analytic Hierarchy Process (AHP). The methods used is described in four steps;
1.Develop a questionnaire to get data from community members living in the selected LGAs
2.Define criteria to rank the project and order the project nominees.
3.Using the multiple criteria techniques, build a decision hierarchy.
4.Allocate weight of each criterion using analytic hierarchy process

3.1 Sampling community member opinion: Delphi Technique

The Delphi technique is a method used by experts to deal systematically with complex problems. This technique is normally used in group communication. In [20], Delphi method was used to ascertain critical success factors by finalizing discussions with expert's critical success factors (CSFs) for the current application of Six Sigma in service sector. All factors were gotten from literature and finalized from discussion with experts concerning the set of critical success factors (CSFs). The Delphi technique was also used to prioritize contractor selection criteria with a precise application. This was used in the Libyan environment to run constructed projects. In [21], the Delphi technique was applied in the development of the valuation equipment for Green and Smart IT level. However, expert opinions using communal participants will be used in this study in selecting factors for the project.

Study Design

The study will be implemented through a questionnaire instrument, such that indications will first be given for preferred criteria for each criterion based on the description of reviewed criterion on information provided for the decision to be taken. Then, after the first step, indicate the most important criteria has to be indicated. The criteria description will be presented again when all the information is available. An example of these indications will first be given for preferred criteria questions is: "Which criterion do you think is more important when choosing a community development project and to what degree?"

Next, they simply have to rank the criteria, they are asked: "Which project selection criteria do you think is the best one? Please select below every method if that method and rank. Herewith, number 1 is best and number 8 is worst." This question should be used as a control measure in comparing scores in AHP and this should be easily understood.

Population

The study population were chosen to reflect gradations in socio-economic status, age and sex. A total of 21 persons were chosen who have resided in Egor and Oredo LGAs. Their preferences on project selection criteria were sampled, through a questionnaire instrument (See Appendix)

Building the AHP- Study Analysis

First and foremost, draw up a good theoretical illustration of the decision. Set a target and state the criteria to formulate the rated community project.

The Analytic Hierarchy Process (AHP) structured to deal with multifaceted resolutions. Thomas L. Saaty developed AHP in the 1970s. Three basic functions are handled by AHP which is designed for feature complexity, bearing on a scale of ratio and synthesizing. The AHP decision methodology is as stated below;

1. Define the problem and also define the goal of the problem
2. Evaluate the hierarchy of the decision from the top with the stated target of the result and then, form a broad perspective to the lowest level through the intermediate levels.
3. Build a set of pair wise comparison matrices. Comparing the upper level elements with the lower elements below. Allocate a number to each of these judgments on a scale as shown in Table 1.
   Considering a number of n elements to be compared $C_1 \ldots . C_n$ let the relative 'weight' (priority or significance) of Ci with regard to C_j by a_{ij} and form a square matrix A= (a_{ij}) of order n with the constraints that a_{ij} = 1/ a_{ij}, for $i \neq j$, and $a$ii=1, all i.
4. Compare using the priorities gotten from it to weigh the priorities immediately below it. Repeat for each element. Then get overall or global priority for each element in the level below add its weighed values. Repeatthe process of weighing and adding till you get the final priorities of the replacements in the lowest level.

Table 1:Saaty scale

Intensity of importance	Definition	Explanation
1	Same importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgment slightly favor one over the other
5	Much more important	Experience and judgment strongly favor one over the other.
7	Very much more important	Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice.
9	Absolutely more important	The evidence favoring one over the other is of the highest possible validity
2,4,6,8	Intermediate values When compromise is needed	Intermediate values When compromise is needed

4. AHP implementation

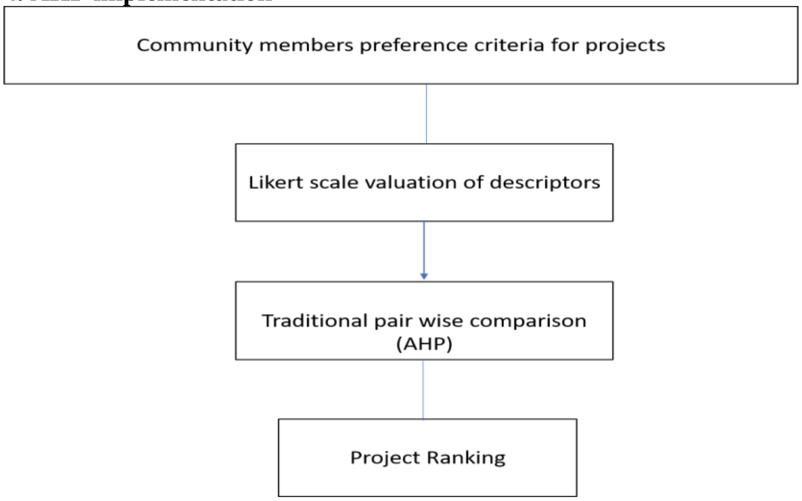

Figure 1: Study Methodology

The AHP from pairwise

Defining the most ideal replacement from a group of projects is a decision problem where the top level of the hierarchy represents the individual project. It is decomposed into a predefined number of characteristics (attributes) on the second level and their corresponding levels on the third level as can In the implementation process of AHP, a survey needs to be carried out where persons are required to make two choice of pairwise comparisons: a) a pairwise comparison of the levels within each attribute (Ln.p); and b) a pairwise comparison of the attributes (An). First, there should be an indication out of the two elements the respondent prefers. Then a nine-point scale is used to evaluate the strength of this preference by means of verbal judgments [22].

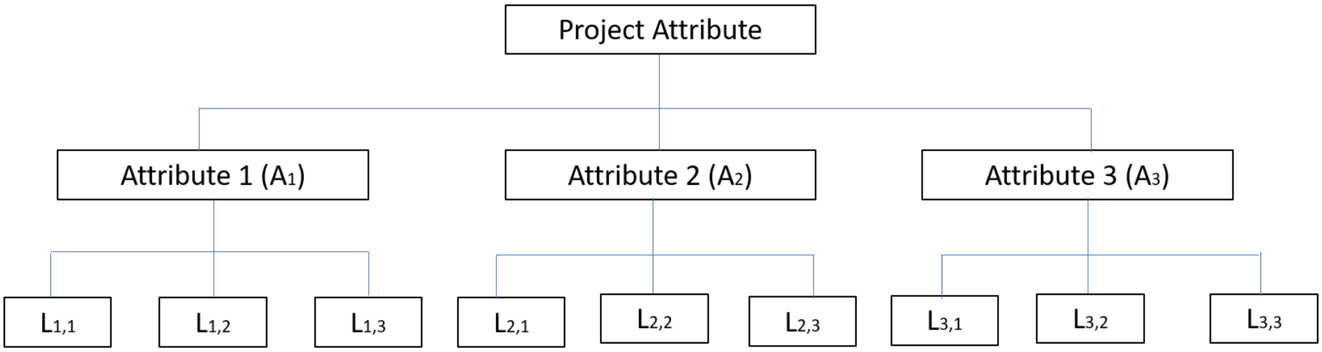

Figure 2: Hierarchical structure used to value product attributes and levels.

Description of the PriEst software

PriEsT means 'Priority Estimation Tool' which is an acronym. It is also an open-source software primarily for decision-making that applies the Analytic Hierarchy Process (AHP) technique - a complete framework for decision complex tasks. PriEsT helps in prioritizing the choices provided in a given instance or situation to decision makers.

PriEsT uses the Analytic Hierarchy Process (AHP) which is commonly used in many sectors of the economy. In fields, such as health sector, transportation sector, telecommunication sector, and decision-making policies. Two major types of problems handled by PriEsT are classification and budgeting problems. In the ranking problems, the decision maker is interested in the order of preference for the provided choices. However, preference weights are needed in budgeting.

Researchers tend to use PriEsT due to its open source nature, PriEsT handles varied prioritization consistency rat, and ratings and techniques and has flexibility of taking in many more.

Mainly, PriEsT supports Pairwise comparison process with any scale for ratio-based decisions; which gives measures for inconsistency in judgements; It gives several non-dominated solutions with the help of Evolutionary Multi-objective optimization; the implementation of the popular used prioritization technique for researches; graphical Equalizer opinions for the pairwise comparison judgements; exports tasks into an XML data file; platform-independent Java-based Tool (runs on Linux, Android and Windows).

5. Results and Discussion

Sex of the respondents

The study made use of 21 respondents in total comprising of 11 males and 10 females.

Educational status of the respondents

Table 2: Educational level of the respondents

Educational Level	Frequency
PhD/Masters	6
BSc. /NCE	8
SSCE	7

Table 2 shows data shows that there was a fair distribution of the respondents across the educational levels.

Criteria Extracted from questionnaires

The criteria for the project selection problem used for this study, are as follows

1. Social impact
2. Cost of the project
3. Economic benefit
4. Projects location

Projects types

a) Borehole projects
b) Road construction
c) Cab transport line
d) Skill acquisition programme for youths

Results for the criteria ranking using a 5-point Likert scale

Table 3 shows the rankings of the different criteria on a Likert scale. The results show that social impact had the highest rating of 4.0, while cost of project was second with a scale of 3.8, followed by economic impact (3.2) and project constraints/risk (3.1).

Table 3: Criteria ranking using a 5-point Likert scale from questionnaire

Factors	Very Important	Important	Good	Fairly important	Not important	Mean score
	5	4	3	2	1	
Social impact	8(38.1%)	7(33.3%)	4(19.0%)	2(9.5%)	0	4.0
Cost of the project	5(23.8%)	7(33.3%)	5(23.8%)	6(28.6%)	0	3.8
Economic benefit	4(19.0%)	3(14.3%)	7(33.3%)	7(33.3%)	0	3.2
Projects location	5(23.8%)	4(19.0%)	5(23.8%)	5(23.8%)	0	3.1

Table 4: Ranking of the various projects by respondents using the criteria

Projects	Social impact	Cost of the project	Economic benefit	Projects location
Borehole projects	3.1	3.7	2.2	3.5
Road construction	4.2	2.5	4.1	3.2
Cab transport line	3.8	2.8	3.9	3.0
Skill acquisition programme for youths	3.2	3.1	3.7	3.1

Ratings of the projects according to the criteria using the PriEsT software

The comparison matrix of the various factors are presented in Table 4 to Table 8, which will be entered into the PriEsT software along with the criteria scales which were then converted to weights by the software, as shown in Figure 3

Table 5: Judgement of the relative priority weightsof criteria using comparison matrix using the PriEsT software

	Social impact	Cost of the project	Economic benefit	Location	Weights
Social impact	1	2	2	2	0.344
Cost of the project	0.5	1	2	2	0.303
Economic benefit	0.5	0.5	1	1	0.193
Location	0.5	0.5	1	1	0.159

Table 6: Judgement of the relative priority weight of alternative projects for social impact using comparison matrix using the PriEsT software

Social Impact	**Borehole projects**	**Road construction**	**Cab transport line**	**Skill acquisition programme for youths**	**Weights**
Borehole projects	1	1	2	2	0.332
Road construction	1	1	2	2	0.332
Cab transport line	0.5	0.5	1	2	0.197
Skill acquisition programme for youths	0.5	0.5	0.5	1	0.139

Table 7: The relative priority weight of alternative projects for cost of project using comparison matrix using the PriEsT software

Cost of project	**Borehole projects**	**Road construction**	**Cab transport line**	**Skill acquisition programme for youths**	**Weights**
Borehole projects	1	2	2	2	0.345
Road construction	0.5	1	2	1	0.244
Cab transport line	0.5	0.5	1	2	0.205
Skill acquisition programme for youths	1	1	0.5	1	0.205

Table 8: The relative priority weight of alternative projects for economic benefit of project using comparison matrix using the PriEsT software

Economic Benefit	**Borehole projects**	**Road construction**	**Cab transport line**	**Skill acquisition programme for youths**	**Weights**
Borehole projects	1	1	2	2	0.359
Road construction	1	1	2	3	0.325
Cab transport line	0.5	0.5	1	2	0.193
Skill acquisition programme for youths	0.5	0.333	0.5	1	0.123

Table 9: The relative priority weight of alternative projects for location of project using comparison matrix using the PriEsT software

Location	Borehole projects	Road construction	Cab transport line	Skill acquisition programme for youths	Weights
Borehole projects	1	2	2	2	0.392
Road construction	0.5	1	2	2	0.278
Cab transport line	0.5	0.5	1	1	0.165
Skill acquisition programme for youths	0.5	0.5	1	1	0.165

Table 10: Over all ranking of alternative projects according to priority

Constraints / Projects	Social impact	Cost of the project	Economic benefit	Location	Weights	Ranking of Results
	0.344	0.303	0.193	0.159		
Borehole projects	0.332	0.345	0.359	0.392	0.294	1
Road construction	0.332	0.244	0.325	0.278	0.248	2
Cab transport line	0.197	0.205	0.193	0.165	0.162	3
Skill acquisition programme for youths	0.139	0.205	0.123	0.165	0.134	4

The priority weights of the alternative projects are calculated from the criteria applied on them that were entered into the software as shown in Figure 3.

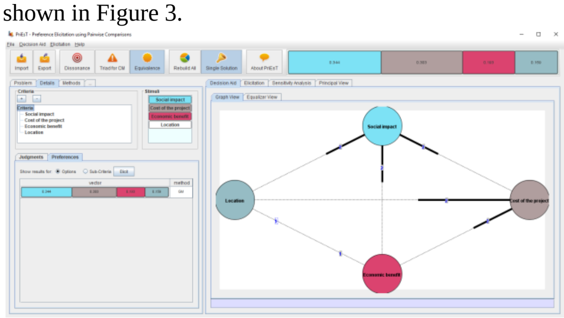

Figure 3: Computing of priority weights of the criteria used for the project selection in PriEst.

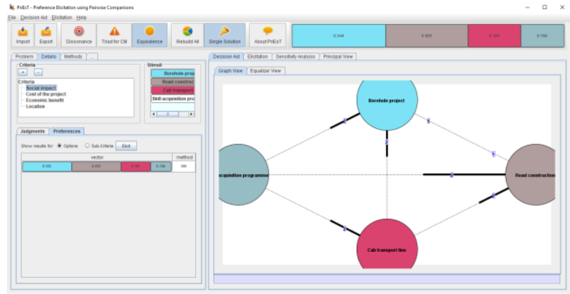

Figure 4: Computing of priority weights of the projects in PriEst using social impact criterion

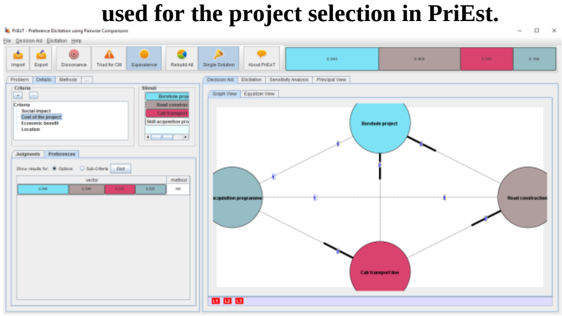

Figure 5: Computing of priority weights ofthe projects in PriEst using cost of project criterion

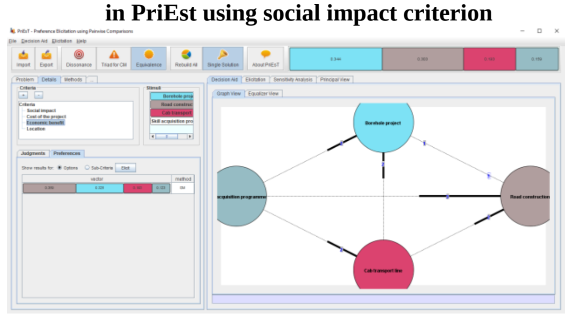

Figure 6: Computing of priority weightsof the projects in PriEst using economic benefit criterion

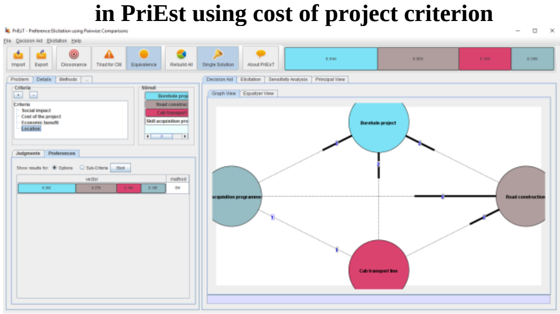

Figure 7: Computing of priority weights of the projects in PriEst using location of project criterion

After imputing the values for the comparison matrices into the PriEst software, automatically the projects were ranked in the following order by way of priority: borehole project (0.294), Road construction (0.248), cab/ transport (0.162) and skill acquisition(0.134) last.

Results discussion

The results are displayed using the main windows of the PriEsT software. The software supports Pairwise comparison method with any scale for ratio-based judgements; making available commonly used measures for inconsistency in judgements; it provides various non-controlled results with the assistance of Evolutionary Multi-objective optimization; implementing all the commonly used techniques for prioritization for researchers; pairwise comparison judgements using graphical and Equalizer views for exporting tasks into an XML data file; Java-based Tool that runs on Linux, Windows and Android which makes it platform-independent.

Conclusion

The AHP technique, has selected the most beneficial projects to be realized at minimal cost toborehole project followed by road construction that will benefit Egor and Oredo Local government area in Edo state most. The connection relationship between these two projects shows the AHP method is a realistic means of realizing project prioritization.

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